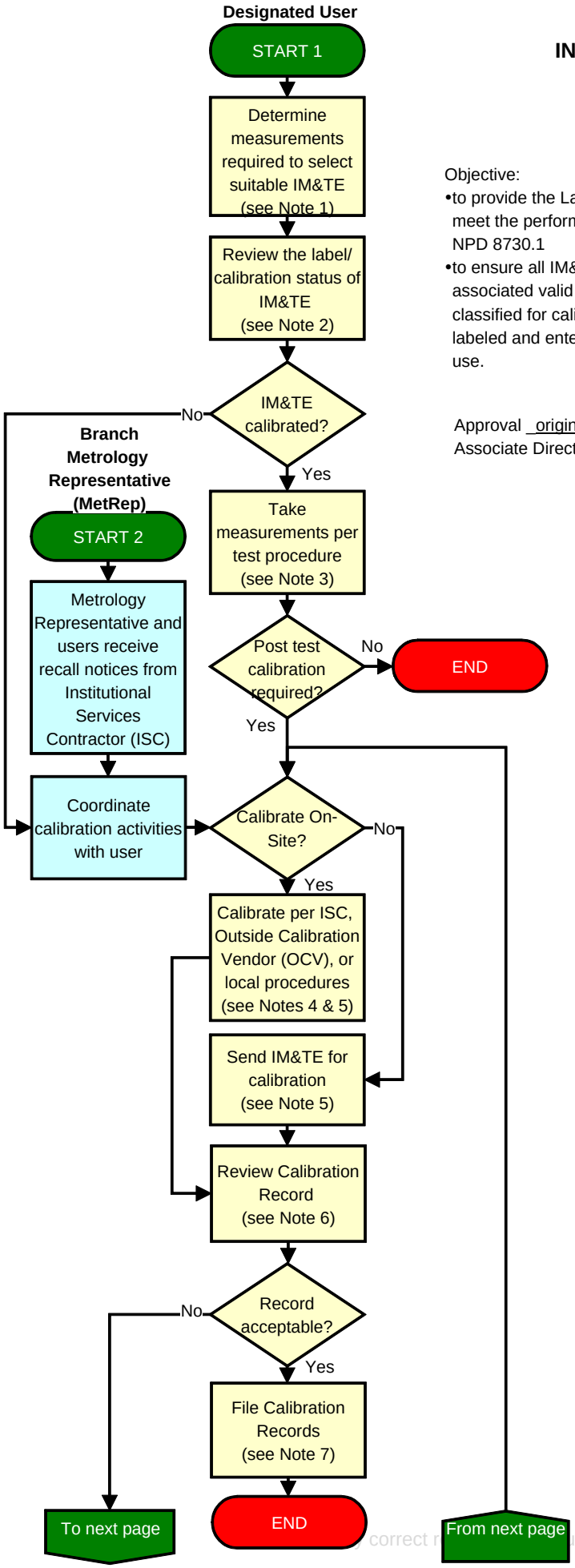
SELECTION, USE AND CONTROL OF INSPECTION, MEASURING AND TEST EQUIPMENT (IM&TE)

LMS-CP-0506
Revision: H-2

Objective:

- to provide the LaRC research community with high-quality, reliable, calibration services that meet the performance requirements of the measurement application and requirements of NPD 8730.1
- to ensure all IM&TE (including safety related instruments) that requires calibration has an associated valid "Designated User" and "Branch Metrology Representative," is correctly classified for calibration requirements, is calibrated with acceptable records, and is properly labeled and entered into the Langley Metrology Information System (MIS) database prior to use.

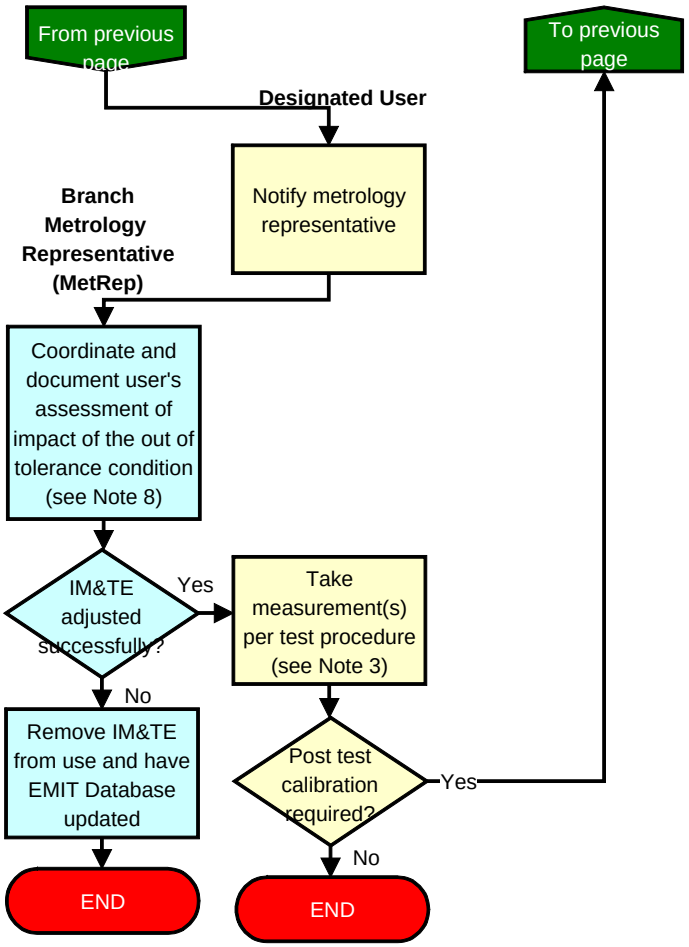
Approval _original signed on file_ Date _2/18/08_
Associate Director



General Information

The following records are generated by this procedure and should be maintained in accordance with CID 1440.7:

- Calibration Records
- Expired Calibration Justification
- Out of Tolerance Evaluation
- IM&TE used in test list
- Calibration Task Descriptions
- Task Description Limited Calibration Approval
- Task Description training and competence



Note 1
Equipment used to perform measurements associated with the following functions must be classified by the "Designated User" as Category 1 or 2 (see LAPD 8730.1, Metrology and the Control of Inspection, Measuring, and Test Equipment, for responsibilities of the Designated User and Note 2 for category definitions), be capable of satisfying application requirements, and have ANSI/NCSL Z540.1-1994 compliant calibration records and labels prior to use (reference NPD 8730.1):

- Acceptance testing (determining that a part, component, or system meets specifications)
- Inspection, maintenance, or calibration
- Flight hardware qualifications
- Measurement of processes where test equipment accuracy is essential for the safety of personnel or the public. Safety related measurement equipment must be Category 1 unless Category 2 is justified in MIS notes by Branch Metrology Representative.
- Telecommunications, transmission, and test equipment where exact signal interfaces and circuit confirmations are essential to mission success
- Development, testing, and special applications where the specifications, end products, or data are accuracy sensitive, including instruments used in hazardous and critical applications.

Follow process described in LMS-CP-0510, Procurement of Inspection, Measuring and Test Equipment, when new measurement equipment is acquired.

Customer supplied IM&TE is to be controlled by following LMS-CP-2737, Incoming Property Loans; the cognizant organizational unit shall be responsible for control of customer supplied measuring equipment and calibration records.

Wind Tunnel balances are utilized by following LMS-OP-0513, Strain Gage Balance Inventory Management.

The current MIS is Equipment Measurement Information Technology (EMIT, http://emit/).

Industrial controls are not part of the calibration system and are not categorized in EMIT unless specifically requested by a Designated User. Industrial controls are maintained in the MAXIMO database and are normally used to establish approximate conditions that are then accurately monitored as needed by Category 1 or 2 research IM&TE. To request industrial equipment service, submit a request through the ROME (Research Operations, Maintenance and Engineering) web site: http://ROME.larc.nasa.gov (click the Request Service Button) or call 4-ROME (757-864-7663).

Note 2
Categories 1 and 2 IM&TE must be labeled with a unique metrology control number (MCN) and included in the EMIT database master list. Categories 1 and 2 IM&TE must have valid calibration records and labels prior to use (see Note 6). Only Category 1 or 2 items may be sent for calibration. Calibration Intervals are established by the ROME metrology services contract

Category definitions:
Category 1: Must have a valid Designated User and Metrology Representative. Refers to items that are automatically recalled for calibration prior to interval expiration via e-mail to designated user and MetRep and are labeled with a "Magenta" sticker. This equipment is used frequently for critical applications and is intended to be calibrated and available at all times. It must be sent for calibration when recalled or a justification for the delay noted in EMIT. Category 1 items receive "as found" and "as left" data along with a statement of traceability.
Category 2: Must have a valid Designated User and Metrology Representative. Refers to items that are not automatically recalled, must be calibrated prior to use if calibration interval has expired and labeled with an "Orange" sticker. This equipment is not used frequently and may be stored un-calibrated for extended periods of time. It shall be stored in an environment that prevents degradation. It is in the calibration system and is intended for use in applications identified in Note 1. Category 2 items receive a statement of traceability only, no data; "as found" data is provided only when requested.
Category N: Does not have a Metrology Representative. Items in this category are labeled with a MCN but do not have an anticipated use for applications identified in Note 1. This equipment is not calibrated (may have an old expired calibration label, no category sticker) and may only be used in applications where substantial accuracy is not required; used for "indication only" purposes in non-hazardous, non-critical applications. Category N items must be changed to Category 1 or 2 if submitted for calibration.
Category R: Does not have a Metrology Representative. Refers to items that have been re-tagged with a new MCN label, labels are sometimes removed by calibration vendors, fall off, or have replaced an ECN (Equipment Control Number). Historical records are available under the old MCN/ECN number by searching EMIT using a Cal. ID of "R;" current records are available under the MCN currently affixed to item.
Category E: Does not have a Metrology Representative. Refers to items that have been excessed from EMIT because they are no longer needed or have been damaged or lost, property management procedures must be followed to formally dispose of the item; historical records are available for evaluation if needed.
Branch Metrology Representatives have the ability to add new equipment or make changes to existing equipment category, location, and users when requested by the Designated User (see LAPD 8730.1 for responsibilities of Metrology Representatives); NEMS (NASA Equipment Management System) is not affected by changes made in EMIT.

THE DESIGNATED USER MUST HAVE A JUSTIFIED REASON FOR USING CATEGORY 1 OR 2 EQUIPMENT BEYOND IT'S RECOMMENDED CALIBRATION INTERVAL BECAUSE OF INCREASED MEASUREMENT RISK. THE JUSTIFICATION MUST BE DOCUMENTED BY THE METROLOGY REPRESENTATIVE IN EMIT NOTES; JUSTIFICATIONS ARE VALID FOR 30 DAYS AND MUST INCLUDE NAME OF PERSON APPROVING THE DELAY, LONGER DELAYS MUST BE RE-JUSTIFIED EVERY 30 DAYS BY ADDING A NEW NOTE IN EMIT. DATA TAKEN AFTER INTERVAL EXPIRATION IS CONSIDERED NON-COMPLIANT UNTIL IM&TE IS PROVEN TO BE IN TOLERANCE WHEN POST CALIBRATION IS PERFORMED. OVERDUE NOTICES WILL CONTINUE TO BE SENT UNTIL EQUIPMENT IS SENT FOR CALIBRATION.

Note 3
Measurements requiring Category 1 or 2 equipment must have records that link the IM&TE to the test. This information is used to evaluate impacts to the test when measurement equipment is found to be out of tolerance when post test calibrations are performed. It also provides technical information about the origin of the test measurement. The records must include the following information and be identified, stored, and maintained in such a way that they are readily retrievable in facilities that provide a suitable environment to minimize damage and prevent loss:
- MCN of IM&TE
- Identification of application or test (test name, number or other unique identifier)
- Dates that IM&TE was used for application or test
- IM&TE designated user name (name of person that selected/approved IM&TE for use in the test).

Note 4

When calibrations are performed on-site by LaRC civil service personnel or through their direction, local calibration procedures must be documented as an approved LMS Task Description (LMS-TD) per LMS-CP-2301; LMS-TD's used to perform calibrations are intended for applications described in Section C of NPD 8730.1, and also note 1 of this procedure. Part of the following requirements are derived from ANSI/NCSL Z540.3-2006. LMS-TD calibration procedures and records must be ANSI/NCSL Z540.1-1994 compliant as per requirements of NPD 8730.1.

Calibrations shall be performed using approved LMS-TD's that:
- address the measuring and test equipment performance requirements (e.g. manufacturers specifications or customer supplied specifications)
- are acceptable to the customer
- are current and appropriate for the calibrations
- are suitable for use by the calibration staff to perform and reproduce a calibration to the established performance criteria. Deviation from calibration procedures shall occur only if the deviation has been documented, technically justified, authorized, and accepted by the customer

NOTE: LMS-TD's may be unique to a specific application or general in nature, applying to multiple applications.

All calibration related LMS-TD's shall:
- contain sufficient information on requirements for the associated measurements and instructions to perform the calibrations. In addition, the number of different measurement quantities and values in a calibration procedure shall be sufficient to ensure conformity of the measuring and test equipment to determined requirements.
- provide for determining and recording the as-found performance of the measuring and test equipment being calibrated
- include requirement to document and send Designated User and Metrology Representative an Out of Tolerance notice

LMS-TD's used as a calibration procedure shall include the following information (see Appendix A for Calibration Task Description Example):
- Name of system or item being calibrated
- LMS-TD number
- authors name, organizational code and effective date
- description of the intended results of the LMS-TD
- scope that includes what equipment is covered and the organizations that are involved
- responsibilities of person performing calibration
- definition of unusual terms and abbreviations
- list of applicable documents referred to (calibration procedures may include the contents of standards, methods and/or manufacturer's procedures supplemented with additional details to ensure consistent application)
- measurement quantities and ranges to be determined for the item to be calibrated and any associated tolerances
- minimum performance requirements of the equipment to be used for calibration, including measurement and reference standards, and reference materials. The accuracy of the reference standards must be four times better than the unit under test or a documented uncertainty analysis must be performed, i.e. a 1.0% calibration requires a 0.25% or better reference standard or a documented uncertainty analysis must be performed
- environmental conditions required and any stabilization period needed
- description of steps associated with the calibration to be performed, i.e. general inspection, set up instructions, calibration specifics
- specify if tamperproof seals are required
- criteria and/or requirements for calibration decisions, such as approval or rejection limits
- data to be recorded (calibration test points) presentation, and method of analysis if required
- require that a category and calibration status label be affixed to the item calibrated. Calibration status labels must include MCN, date calibrated, date due, calibration interval and identity of person performing calibration; limited calibration labels must reference limitations and be easily identified
- description of close out procedures
- requirement to send completed records to the Institutional Services Contractor (ROME/SIMCO) to update EMIT; system calibration records are maintained by the organizational unit (see note 7)

The calibration records generated from a LMS-TD shall include the following:
- organizational code and identification of the location that calibrations were performed
- description and unique identification of the measuring and test equipment (MCN, manufacturer, model, nomenclature, serial number, etc.)
- identification of the LMS-TD used
- identification of relevant environmental conditions, including required measurements of conditions that affect the calibration results (temperature, humidity, pressure, etc.)
- date on which the calibration was completed and date calibration is due
- identification of the NIST(National Institute of Standards and Technology) traceable reference standard(s) used; must include MCN, calibration due date, description, range and accuracy of all reference standards used
- as-found measurement performance condition of the equipment; indicate all out of tolerance readings
- indication that the as-returned calibration results meet the specified measurement performance requirements of the equipment or identify limitations of use with documented customer approval (limited calibration approval must be documented by Metrology Representative in EMIT notes and indicated in the Remarks section)
- calibration actions taken (adjusted, repaired, new value assigned, limited, derated, modified, etc.)
- uncertainty of measurement, where appropriate, and/or a statement of the extent of conformance to identified requirements
- assigned calibration interval and date calibration expires (search EMIT by exact model number to identify correct calibration interval; if not found in EMIT, submit ROME integrator request to determine interval)
- signature of person performing the calibration
- signature of person performing the quality review of the calibration record

NOTE: Identification of person to perform the quality review is the responsibility of the Branch Manager, must not be the person performing calibration
See LF 231 and LF 456 for generic templates.

The branch management of personnel performing the calibration and quality review of calibration records are responsible for ensuring that appropriate training related to LMS-TD calibration activities are kept up-to-date and consistent with the employee assignments. Documentation of training, skills, experience and competence related to LMS- TD's may be controlled through SATERN and/or local records maintained by the Organizational Unit; the person(s) responsible for maintaining and approving the local records must be identified.

Note 5
Calibration may be performed by the Institutional Services Contractor (ISC) or by an Outside Calibration Vendor (OCV). LaRC has two ISC's: Research Operations, Maintenance, and Engineering (ROME) contract for routine and special metrology calibrations for the majority of LaRC equipment; and Force Measurement Support Services (FMSS) contract for the calibration or service of: aircraft scales, analytical balances, cable tensiometers, crane scales, dynamometers, force gauges, hydraulic presses, load cells and digital indicators, platform scales, swage terminal testers, tensile testers, torque wrenches, torque testers, torque multiplier, weights.

To have instruments calibrated by ROME. Contact the Branch Metrology Representative for information on how to use a Certified Data Acquisition (CERDAAC) electronic shipper form or call 873-1978 for help. You may also call 864-7663 or access the ROME web site at http://ROME.larc.nasa.gov and submit LF 145, Maintenance Shipping Form (A funded ROME Tracking Number (RTN) must be provided when submitting a request; contact organizational Metrology Representative to obtain information about RTN's; if performance requirements other than manufacturers specification are required, customer supplied requirements must be provided to the calibration laboratory. Call 873-1978 to request on-site calibrations.

To have force related instruments calibrated by FMSS. Contact the Branch Metrology Representative for information on how to use a Certified Data Acquisition (CERDAAC) electronic shipper form or call 873-1978 for help. You may also call 864-7663 or access the ROME web site at http://ROME.larc.nasa.gov and attach LF 145; an organizational code must be provided when submitting request (RTN's are not required for FMSS calibrations), For quick turnaround or an urgent request call 873-8235 or 873-1212 and attach LF 145; if performance requirements other than manufacturers specification are required, customer supplied requirements must be provided to the calibration laboratory.

To have instruments calibrated by an OCV or non-ISC contractor. Instruments must be shipped (using LF 52, Shipping/Transfer Document) or calibrated on-site by a vendor that is ANSI/NCSL Z540.1-1994 compliant as per NPD 8730.1 (may additionally be compliant to ANSI/ISO/ 17025:2000 or ANSI/NCSL Z540.3-2006 when appropriate). It is the users responsibility to request "as found" and as left data for category 1 items (and category 2 items if required). OCV calibration records must be uploaded to CERDAAC/EMIT. Metrology Representatives can provide instructions on how to initiate the record upload by creating a no cost paperwork only shipper. If performance requirements other than manufacturers specification are required, customer supplied requirements must be provided to the calibration laboratory.

Note 6
Calibration records shall be reviewed to ensure:
the range of readings taken is suitable for the application
the test results meet the defined acceptance criteria
all standards used are traceable to nationally or internationally recognized standards
the uncertainty of the measurement has been recorded
the calibration dates, calibration interval, and category labels are correct and agree with information in EMIT. If the labeling on the instrument does not agree with the EMIT, contact the LaRC Metrology Officer for resolution.

Note 7
Calibration Records generated by either ISC (ROME or FMSS) will be maintained and stored in the EMIT database.

Calibration Records generated by Task Descriptions or OCV"s must be Z540.1 compliant (may additionally be compliant to ANSI/ISO/ 17025:2000 or ANSI/NCSL Z540.3-2006 when appropriate) and uploaded into CERDAAC/EMIT. The Metrology Representative can assist with updating EMIT calibration dates by uploading records into CERDAAC/EMIT.

Calibration or Check Standard Records generated by frequent on-site system calibrations or verifications will be maintained by the organizational unit in such a way that they are readily retrievable in facilities that provide a suitable environment to minimize damage and prevent loss.

Note 8
If the calibration results do not meet the defined performance requirements, an assessment of the impact of the out of tolerance condition on previous test results must be performed and documented in EMIT notes within 30 days (contact Branch MetRep for assistance). All accuracy sensitive measurements taken with the identified equipment since its last valid calibration must be evaluated. The significance of the error(s) must be determined based on the identified performance requirements specified for the measurements application(s) involved.

If the assessment indicates the risk of significant errors in any of the measurements made with the equipment prior to calibration, corrective actions shall be defined and implemented. The customer(s) of any product considered at a significant risk shall be notified.

Appendix A: Calibration Task Description Example

(note: blue/italicized text indicates author inputs, examples or instructions; black text or equivalent is suggested to be part of final document; task descriptions must be submitted for management approval per LMS-CP-1401 prior to use)

Calibration Procedure for: *name of system or item calibrated* *LMS-TD- xxxxx*

Author: _____ Effective Date: *mm/dd/yyyy* Org. Code: _____

1. DESCRIPTION

This Task Description is intended to result in LMS-CP-0506 compliant calibration records. It identifies the responsibilities of the Calibrating Organization as they relate to the calibration of *(name of system(s) or item(s) calibrated)*. All IM&TE used in applications identified in section "c" of NPD 8730.1 must be calibrated and have labels and records as described in LMS-CP-0506 prior to use. The calibration results are intended to meet either manufacturer's specifications or specific customer supplied requirements when provided.

2. SCOPE

This Task Description applies to all *(name of system(s) or item(s) calibrated)* when the calibration is performed on Center by civil servant or contractor staff. Calibration Services Contractors or civil servants may alternately use contractor generated procedures if they result in Z540.1 compliant calibration records that are included in the LaRC Metrology Information System (MIS) as described in LMS-CP-0506.

3. RESPONSIBILITIES

3.1. It is the responsibility of all individuals who calibrate *(name of system(s) or item(s) calibrated)* to comply with this Task Description and to assure that it is current and appropriate for calibrations.

3.2. The person responsible for the calibration of *(name of system(s) or item(s) calibrated)* will accomplish the following preliminary operations prior to beginning calibration: *(any special considerations; establish environmental conditions, warm-up time, stabilization/equilibrium, cleaning, eye protection or other personal protection, etc.)*

4. DEFINITIONS

4.1. *Define any abbreviations or other unusual terms as needed*

4.2. IM& TE - Inspection, Measurement, and Test Equipment

4.3 MCN – Metrology Control Number

5. APPLICABLE DOCUMENTS

5.1 List any documents referred to or utilized, i.e. manufacturers calibration procedure; be specific, include Title, description, page numbers or chapter, date and revision number

IM&TE SPECIFICATIONS (UNIT UNDER TEST)
(items to be calibrated; procedure may apply to different mfg's & models with similar parameters)

Nomenclature	Manufacturer.	Model	Range	Accuracy (pass/fail limits)
Item description	*NAME*	*NUMBER*	*XX units to XXXX*	*±XX units ± X.X % of Rdg*
Item description	*NAME*	*NUMBER*	*XX units to XXXX*	*± XX units*
Item description	*NAME*	*NUMBER*	*XX units to XXXX units*	*X.X % of F.S.*

REFERENCE EQUIPMENT REQUIREMENTS (STANDARDS) NIST TRACEABLE

NOMENCLATURE	RANGE	Accuracy, Minimum Performance requirements (*specify units*)
Item description	*XX units to XX units*	*±XX units ± X.X % of Rdg*
Item description	*XX units to XX units*	*± XX units*
Item description	*XX units to XX units*	*±XX units ± X.X % of F.S.*
Item description	*XX units to XX units*	*±X.X % of F.S.*

6.0 PROCEDURE

6.1. General inspection

6.1.1. *Describe any applicable pre-calibration inspections: visual inspection of physical integrity, battery condition/ charge level, loose connectors/knobs, etc.*

6.2. Instructions

6.2.1. *Clearly describe how to set up the equipment, special fixtures, cables, utilization of special connectors, software, etc.; include required environmental conditions (equipment used to measure critical environmental conditions must be in the reference standards used chart), stabilization period and any other requirements that must be met, pay special attention to factors that will negatively influence calibration outcome.*

6.3. Calibration Specifics

6.3.1. *This portion must contain sufficient information on requirements for the associated measurements and instructions to perform the calibrations in clearly identified steps; in addition, the number of different measurement quantities and values in this procedure shall be sufficient to ensure conformity of the measuring and test equipment to determined requirements. Describe in detail all physical steps required to take specified measurement readings from the name of system(s) or item(s) calibrated and the reference standard used for comparison, be specific and clear about any switch settings, wave forms, wiring requirements & polarity, connector type/locations, alignments, etc;. Identify criteria and/or requirements for calibration decisions such as approval or rejection. Specify if Tamperproof seals to exposed calibration adjustments are required after calibration is complete*

IM&TE (unit under test) CALIBRATION POINTS

Nomenclature	Manufacturer	Model	Function	Range	Calibration Test points in inches
micrometer	*Acme*	*242*	*Length*	*0-1 inch*	*0.000, 0.200, 0.400, 0.600, 0.800, 1.000, 0.800, 0.600, 0.400, 0.200, 0.000*

6.4. Record of Calibration Results *(See LF 231 and LF 456 for generic templates)*

Records must include:

- *organizational code and identification of the location that calibrations were performed*
- *description and unique identification of the measuring and test equipment (MCN, manufacturer, model, nomenclature, serial number, etc.)*
- *identification of the LMS-TD used*
- *indication of relevant environmental conditions that affect the calibration*
- *date on which the calibration was completed and date calibration is due*
- *identification of the NIST(National Institute of Standards and Technology) traceable reference standard(s) used (MCN and calibration due date)*
- *as-found measurement performance condition of the equipment (all Category 1, Category 2 as needed)*
- *indication that the as-returned calibration results meet the specified measurement performance requirements of the equipment or identify limitations of use*
- *requirement to document and send Designated User and Metrology Representative an Out of Tolerance notice (Category 1, Category 2 as needed)*
- *calibration actions taken (adjusted, repaired, new value assigned, limited, derated, modified, etc.)*
- *uncertainty of measurement, where appropriate, and/or a statement of the extent of conformance to identified requirements*
- *assigned calibration interval and date calibration expires (search EMIT by exact model number to identify correct calibration interval; if not found in EMIT, submit ROME integrator request to determine interval)*
- *signature of person performing the calibration*
- *signature of person performing the quality review of the calibration record*
- *requirement to send completed records to the Institutional Services Contractor (ROME/SIMCO) to update EMIT; system calibration records are maintained by the organizational unit (see section 7)*
- *NOTE: Identification of person to perfrom the quality review is the responsibility of the Branch Manager, must not be the person performing calibration*

7. UPDATE METROLOGY INFORMATION SYSTEM (EMIT)

Contact the Branch Metrology Representative for information on how to upload completed and signed Calibration records into the LaRC Metrology Information System (MIS); system calibration records are to be maintained by the organizational unit, ensure as found data is provided for all Category 1 calibrations; ensure calibration status label is affixed that includes: MCN, date calibrated, date due, and technician identification, ensure Category 1 or 2 label is affixed, limited calibration labels must reference limitations and be easily identified, document notification sent to Designated User and MetRep of any as found Out of Tolerance conditions that includes enough information for user to assess impact on previous use (evaluation to be documented in EMIT notes by MetRep, see LMS-CP-0506)

8. CLOSE OUT PROCESS

Describe any shut down and close out requirements including power down sequence, disconnection process and storage requirements of calibration related equipment